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## EDITORIALS/OPINION

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## Try a Commonsense Response to Global Warming

By James Hansen

NEW YORK — Evidence continues to build that the world is slowly getting warmer. Almost all mountain glaciers are retreating. It was discovered this year that even the deep ocean is warming. On Earth's surface, where people live, the average warming is now about half a centigrade degree in the past 100 years.

Half a degree seems hardly noticeable. It is much less than weather fluctuations that occur every day. But it is a warning of possibly large climate changes as the 21st century progresses.

One worry is sea level, which will rise as glaciers melt and as ocean water expands from warming. A rise of a meter, a possibility this century, would submerge island nations such as the Maldives and the Marshall Islands, and it would be devastating to people living in Bangladesh and on the Nile Delta.

The greatest effect of global warming for most people may be an increase in extreme weather. Global warming is expected to cause more droughts and forest fires. It increases evaporation, which will lead, at other times and places, to heavier rainfall and floods.

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The forces that drive global warming are no surprise. They are mainly the gases and fine particles that humans have been dumping into the atmosphere for many years. The gases, especially carbon dioxide and methane, absorb Earth's heat radiation and thus warm the surface, just as a blanket traps body heat. Fine particles of soot (black carbon) warm the air by absorbing sunlight.

Other human-made fine particles, especially sulfates, are nearly white. Sulfates come from sulfur in coal and

oil, which is released to the atmosphere when these fossil fuels are burned. Sulfates cool Earth by reflecting sunlight back to space.

The net effect of these human emissions is not accurately known, because the fine particles are not yet measured well. But it is estimated that the net heating is at least one watt, perhaps closer to two watts, per square meter. Such a human forcing of climate is comparable to increasing the brightness of the sun by 1 percent.

Earth responds slowly to such forcings. The thermal inertia of the ocean delays the response. It takes decades for most of the response to occur, and centuries for the full response.

The question we face today is how much more we should allow human climate forcing to grow. That question is being addressed now in The Hague by the world's nations.

These deliberations are guided by climate simulations carried out by the Intergovernmental Panel on Climate Change. The simulations focus on a gloomy scenario in which it is assumed that humans will burn coal, oil and gas at faster and faster rates.

This gloomy scenario leads to an additional forcing of three watts in the next 50 years. Such a forcing will almost surely lead to increases in climate extremes and a rising sea level.

Some increase in human climate forcing is inevitable. Fossil fuels are our primary source of energy. Because of the energy infrastructure, it requires decades to phase in new technologies that may produce less carbon dioxide.

However, we recently suggested a scenario that reduces the human forcing to only one watt in the next 50 years. This would yield a more moderate climate change, allowing time to understand climate change better and develop technologies and strategies to deal with it.

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There are two elements in this commonsense solution to global warming. First we must stop the growth of air pollution. This would eliminate any added climate forcing by constituents other than carbon dioxide. Second we must burn fossil fuels, and thus emit carbon dioxide, no faster than we do today. That means that growing energy needs must be met by increased efficiencies in current uses and by introducing technologies that produce little or no carbon dioxide.

Both elements are achievable but unlikely to happen by accident. Technologies that reduce air pollution have to be applied. Annual growth of carbon dioxide emissions, which has already slowed from 4 to 1 percent per year, must be slowed a bit further to zero growth or a small decrease.

Many actions could reduce both air pollution and carbon dioxide emissions. We need to develop clean fuels and renewable energy sources, and remove barriers to energy efficiency. Improved technology, perhaps including fuel cells and hydrogen power, can help reverse the trend to greater gas-guzzling vehicles. Utility profits should be designed to reward improved efficiency and decreased air pollution.

Improved energy efficiency, cleaner uses of fossil fuels and development of

renewable energy sources will have multiple benefits. In addition to slowing the growth of carbon dioxide, this will create jobs, improve economic competitiveness, reduce reliance on foreign sources of energy and improve public health.

Fine particles in air pollution, including soot, sulfates and organic aerosols, penetrate human tissue deeply, causing respiratory and cardiac problems. A recent study found that air pollution in France, Austria and Switzerland alone accounts for 500,000 asthma attacks and 40,000 deaths per year. Air pollution in developing countries, such as India and China, is even more severe.

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International cooperation is needed, because emissions circulate worldwide. But benefits of progress, in climate stabilization and health, will be similarly widespread. Required cooperation, including technology transfer, can include incentives and economic opportunities for all parties.

The commonsense approach is to move forward by attacking air pollution, improving energy efficiency and developing renewable energy sources. This approach is economically sound and has collateral benefits. It should provide a meeting ground for persons from a wide spectrum of political viewpoints, all of whom wish to preserve the environment.

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